METAL CASTING

Project Fact Sheet

CLEAN METAL CASTING

BENEFITS

Nearly 55% of the energy used in metal casting operations is for melting. Savings in this phase of the metal casting process will result in important energy and environmental benefits for the industry.

Moreover, improved understanding and application of molten metal treatment operations can greatly increase the quality of finished aluminum products. This will greatly enhance the competitiveness of U.S. metal casters in ever-expanding markets for cast aluminum products.

APPLICATIONS

Research findings and high temperature phase separation technology development can be applied throughout the industry for virtually all aluminum castings.

Dissemination of research findings and guidelines is being conducted through the American Foundrymen's Society, the U.S. Department of Energy and by WPI researchers themselves.

DEVELOPMENT OF HIGH TEMPERATURE PHASE SEPARATION TECHNOLOGY

This research program, conducted at the Worcester Polytechnic Institute (WPI) - Aluminum Casting Research Laboratory, is developing the technology base for clean metal processing on the foundry floor. The ability to produce consistent levels of melt cleanliness will allow industry to reduce scrap -- translating into increased productivity and competitiveness. The following reviews the development of *phase separation technology* under this research program. A separate fact sheet has been developed on melt cleanliness assessment and melt contamination avoidance.

The quality of finished aluminum products depends largely on melt treatment prior to casting. Molten metal treatment operations commonly used in the clean metal processing of foundry and wrought aluminum alloys include:

- **Sedimentation** - *The body force separation of large inclusions by melt quiescence.*
- **Fluxing** - *The removal of dissolved hydrogen by mechanical displacement and separation of moderately-sized inclusions by floatation.*
- **Filtration** - *The separation of small inclusions by mechanical entrapment on the surface of the filter; and even smaller particles by physical, chemical, and/or electrostatic attachment to filter walls.*

Gaps exist in the fundamental understanding of these operations. WPI is developing computer models to simulate fluxing, flotation and sedimentation processes. They will verify simulation results in the laboratory and at industrial sites. The results will be used to determine the effect of various process parameters on process efficiency with the ultimate goal of developing guidelines for an optimized degassing methodology.

DEGASSER SIMULATION

- Aluminum flow field in a conventional degasser rotating at 675 rpm.
- Argon gas distribution in the melt treatment furnace in a conventional degasser rotating at 675 rpm.
- Aluminum melt flow field in a reverse rotation degasser rotating at 675 rpm - cycles every 25 seconds.
- Argon gas distribution in the melt treatment furnace in a reverse rotation degasser rotating at 675 rpm -- cycles every 25 seconds.

WPI simulations show considerably more turbulence and much better gas bubble distribution in the reverse rotation degassers which are conducive to better inclusion removal.

Project Description

Goal: The goal of this project is to develop a technology for clean metal processing that is capable of consistently providing a metal cleanliness level that is fit for a given application. Ultimately, it is designed to reduce the incidence of defects which cause scrap and poor yields, thereby reducing remelting costs. Among the tasks included in this project are:

1) The development of melt cleanliness assessment technology
2) The development of melt contamination avoidance technology
3) Development of high temperature phase separation technology
4) Establishment of a correlation between the level of melt cleanliness and as-cast mechanical properties
5) Transfer technology to industry

This fact sheet discusses Task 3, the development of high temperature phase separation technology.

Progress and Milestones

Task 3: Phase Separation Technology

- A critical literature review of the existing phase separation technology has been completed.
- WPI is developing practical guidelines to control sedimentation processes in industry.
- WPI is developing recommendations for the use of fluxing gases.
- WPI is investigating the effect of moisture content on the effectiveness of fluxing gases in hydrogen removal and inclusion flotation.
- WPI is investigating the feasibility of developing filter media with enhanced inclusion sinter-capture mechanism.

PROJECT PARTNERS

American Foundrymen's Society, Des Plaines, IL

FOSECO, Cleveland, OH

Hitchcock Industries, Minneapolis, MN

Kennedy Die Castings, Inc., Worcester, MA

Madison-Kipp Corp., Madison, WI

Palmer Foundry, Palmer, MA

Selee Corporation, Hendersonville, NC

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